March 20, 2012

# Naval Precision Weapons Session

## *PMA-201/OPNAV N98/JHUAPL*

***Prepared For:***
**PSA, Annual Review 2012**

***Prepared By:***
**Maj Craig McDermott**
**Brian Kelly**
**Kerry Neace**


# Net Enabled Weapons (NEW)
# Support to ASuW

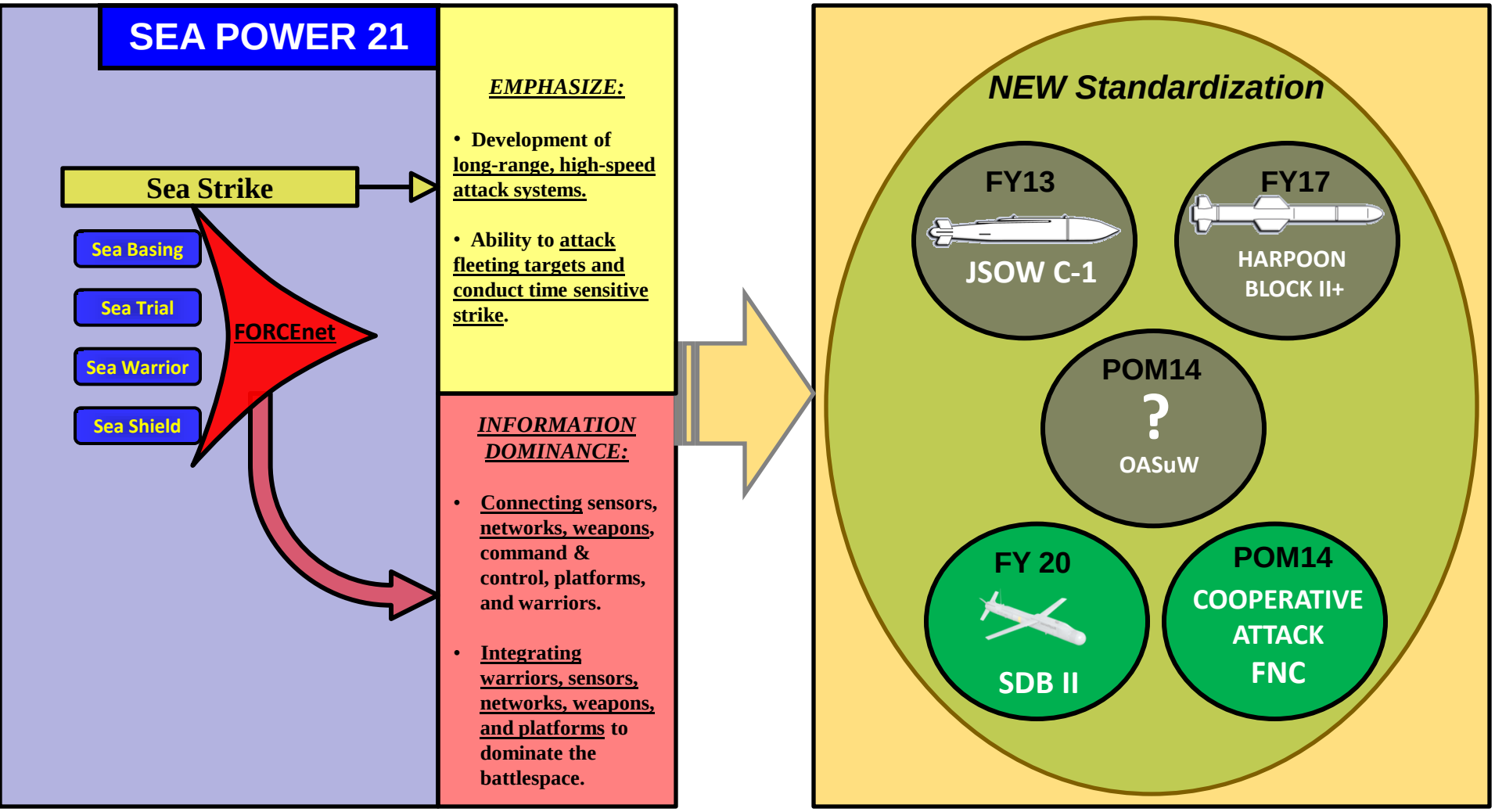
**Brian Kelly**
**Precision Strike Weapons**
**March 2012**
**Brian.p.Kelly@navy.mil**

# BLUF

- Net Enabled Weapons are critical to supporting the ASuW mission and the Navy's strategic vision
  - Allow for the receipt of In-Flight Target Updates (IFTUs) that improve the targeting and engagement of Moving Maritime Targets
  - In-flight Retargeting/Reallocation
  - In-flight Abort

- PMA201 is taking a leading role in the ASuW mission
  - Net Enabled Weapon portfolio
  - Sensor to Weapon 3PS Targeting (S2W 3PS)
  - Weapon to Weapon Coordination (Cooperative Attack)

# Supporting the Strategic Vision




***PMA201 is Meeting the Challenge!***

# Network Enabled Weapon (NEW)

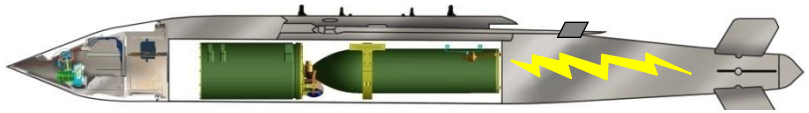
*Joint Standoff Weapon (JSOW) C-1*

| Schedule | FY06 | | | | FY07 | | | | FY08 | | | | FY09 | | | | FY10 | | | | FY11 | | | | FY12 | | | | FY13 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FY by Quarters | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV | I | II | III | IV |
| Milestones | | | | | | | | | | | | | | | | | | | | | | | | | | | OTRR | | | IOC | | |
| Development | Block II/SAASM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Block III Study | | | | Block III/WDL (C-1) | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Developmental Testing | DT-IIIB (DT-DT/OT) | | | | | | | | DT-IIIC | | | | DT-IIID | | | | | | | | | | | | | | | | | | | |
| Operational Testing | | | | | | | | | OT-IIIA | | | | | | | | | | | | | | | | IT&E | | | | OT-IIIB | | | |
| Production Awards / Deliveries | FRP-2 | | | | FRP-3 | | | | FRP-4 | | | | FRP-5 | | | | FRP-6 | | | | FRP-7 | | | | FRP-8 | | | | FRP-9 | | | |
| | LRIP-2 | FRP-1 | | | | FRP-2 | | | | FRP-3 | | | FRP-4 | | | | | | | | FRP-5 | | | | FRP-6 | FRP-7 | | | FRP-8 | | | |

## Program Description

- ACAT 1C // Navy Program
- Contractor: Raytheon Missile Systems
- Requirement: Adverse weather standoff outside point/area defenses against fixed/re-locatable stationary land targets (area, point, and hardened targets with blast/frag and penetration).
- First free flight test completed July 2011
- JSOW C-1 will be the 1st Network Enabled Weapon (NEW) deployed

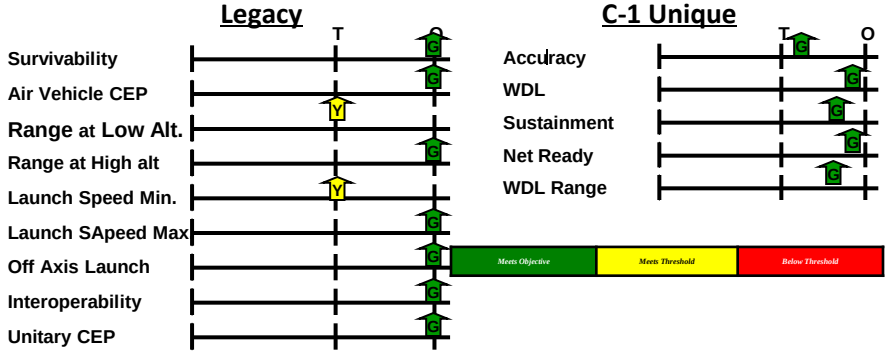
## JSOW Unitary (AGM-154C-1)



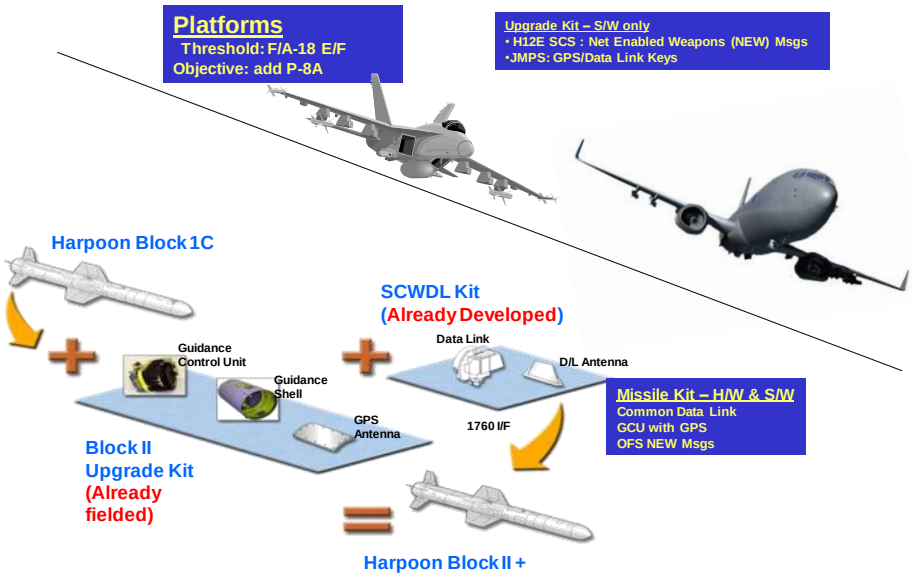
- Uncooled Commercial $I^2R$ Sensor with ATA
- GPS/INS Guidance for flyout
- Terminal Seeker, Increased $P_K$, Precision Accuracy
- Broach Warhead, Blast / Fragmentation / Penetrator
- Link-16 Strike Common Weapon Data Link (SCWDL)
- Stationary Land & Maritime Moving Targets

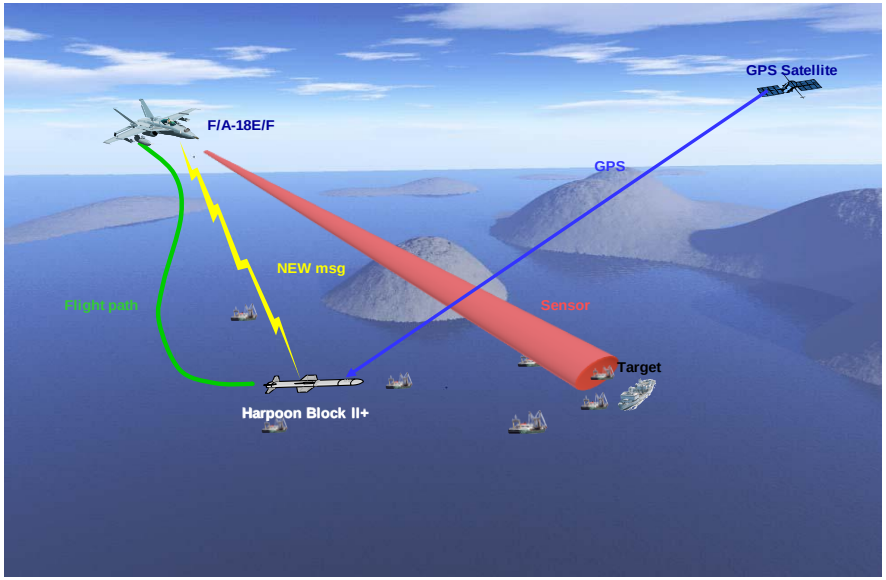
**In Development - 2013 IOC**

### Key Performance Parameters



# Network Enabled Weapon (NEW)
*Harpoon Block II+*

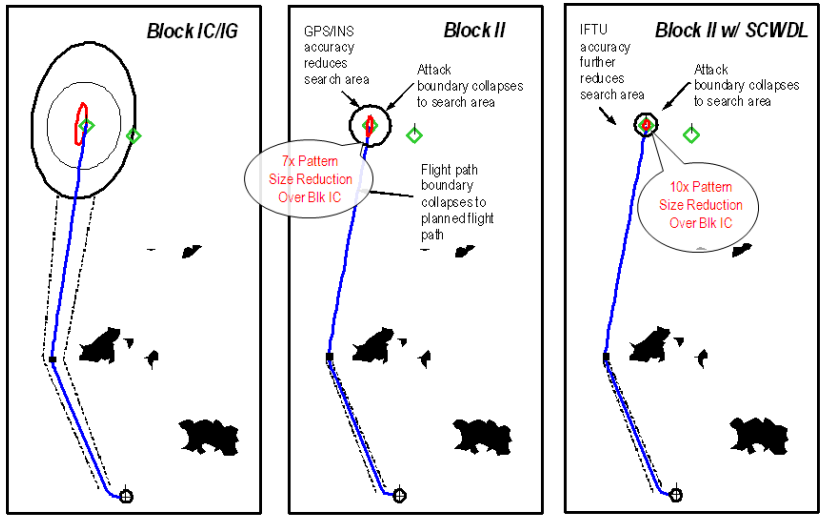



**Air-Launch OV-1**

## Program Description

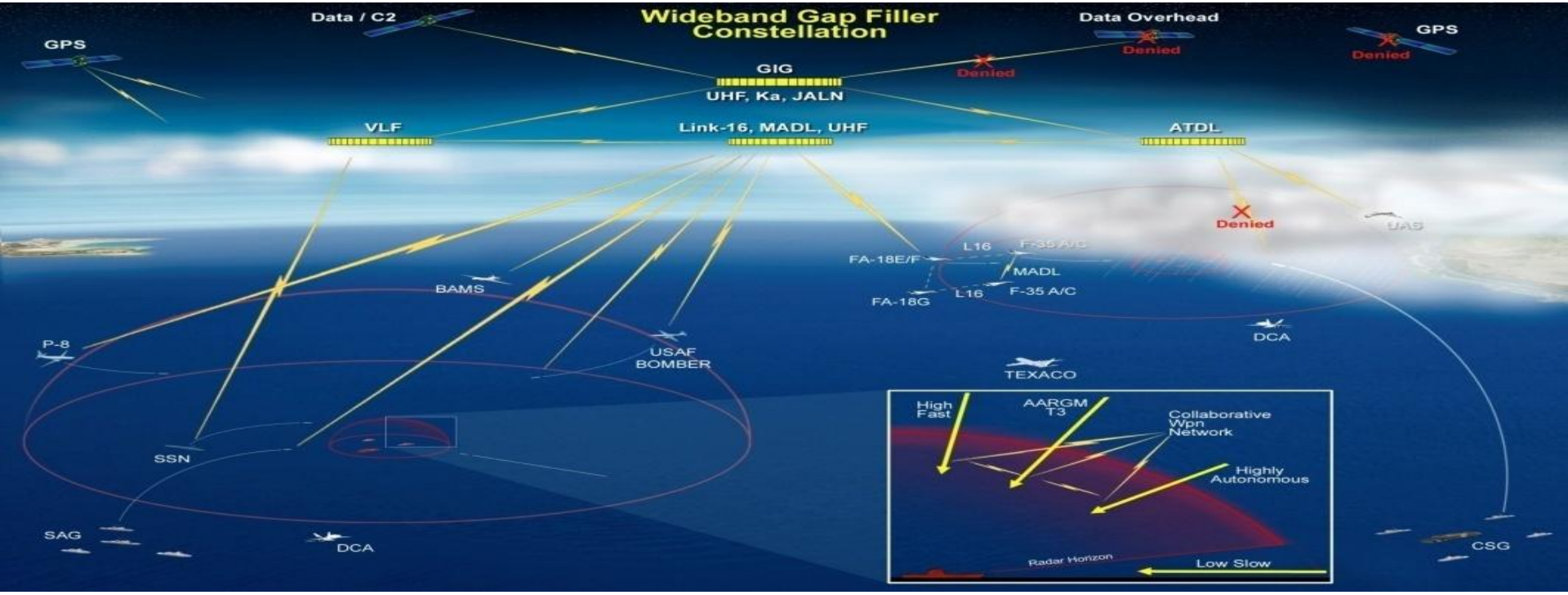
- **Designated an Abbreviated Acquisition Program (AAP)**
- **Sales Exchange Agreement with Boeing**
- **Provides a Navigational Update to the Harpoon Blk 1C**
  - **Includes GPS/INS & SCWDL**
  - **Network Enabled Weapon**
- **IOC/Fleet Release FY17**




*Harpoon Block II GPS/INS & SCWDL Significantly Decreases Non-Target $P_{acq}$*

# Network Enabled Weapon (NEW)

*OASUW AoA*




## Requirements

- **Network enabled / not network dependent**
- **Perform at extended ranges under a wide range of targeting conditions (weather, jamming, etc.)**
- **Surface/Air launched**
- **Survivable**
- **Near 2018 long 2024 solution**
- **Near 2018 ECP to existing Program of Record**
- **Harpoon, SM6, Tomahawk, LRASM, JSOW, SLAM-ER**

## Schedule

- **CBA Approved May 2010**
- **JROC Approved ICD – Nov 2010**
- **MDD ADM – Jan 2011**
- **MPCR 0-7 Pre-Brief – 14 Mar 2011**
- **MPCR R3B – 16 Mar 2011**
- **AoA ESC/AAG out brief – 09 Mar 2011**
- **AoA Quick Look – Jul 2011**
- ***MS A – Jun 2012**
- ***MS B – 2017**
- ***MS C - 2020**
- ***IOC – NLT 2024**

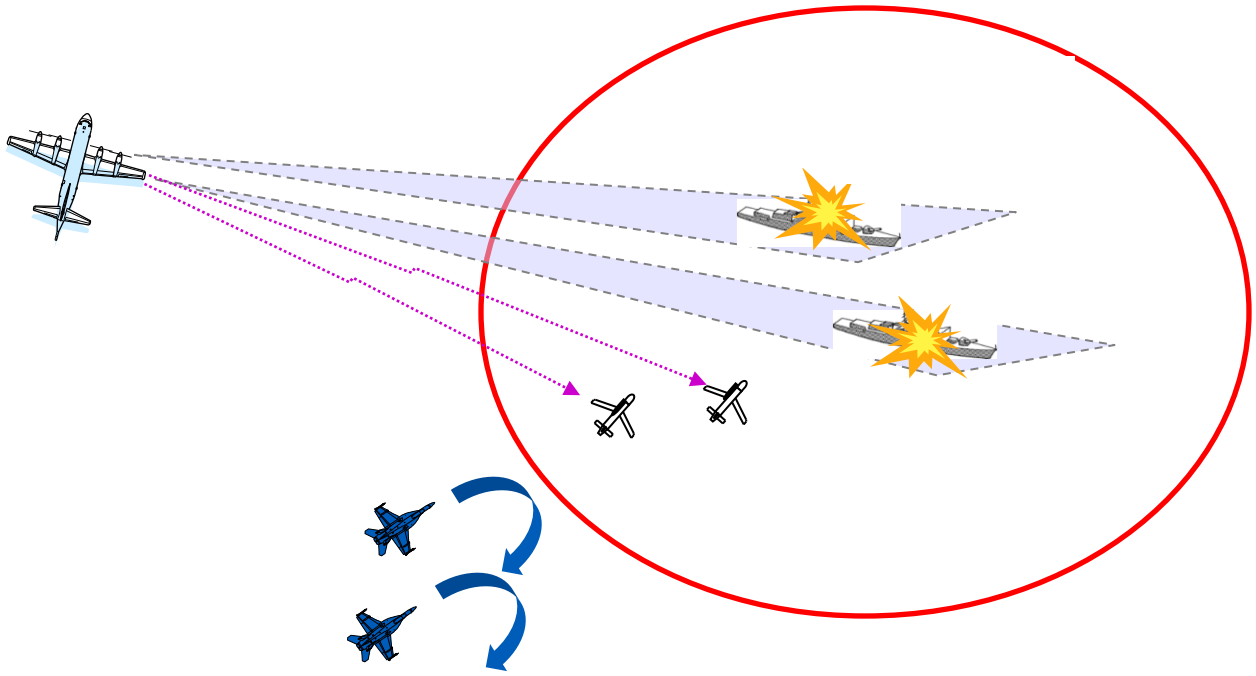
* **Dependent on results of AoA that concludes in CY11**

## Issues

- **Affordability**
- **Kill Chain Wholeness**
- **Schedule**

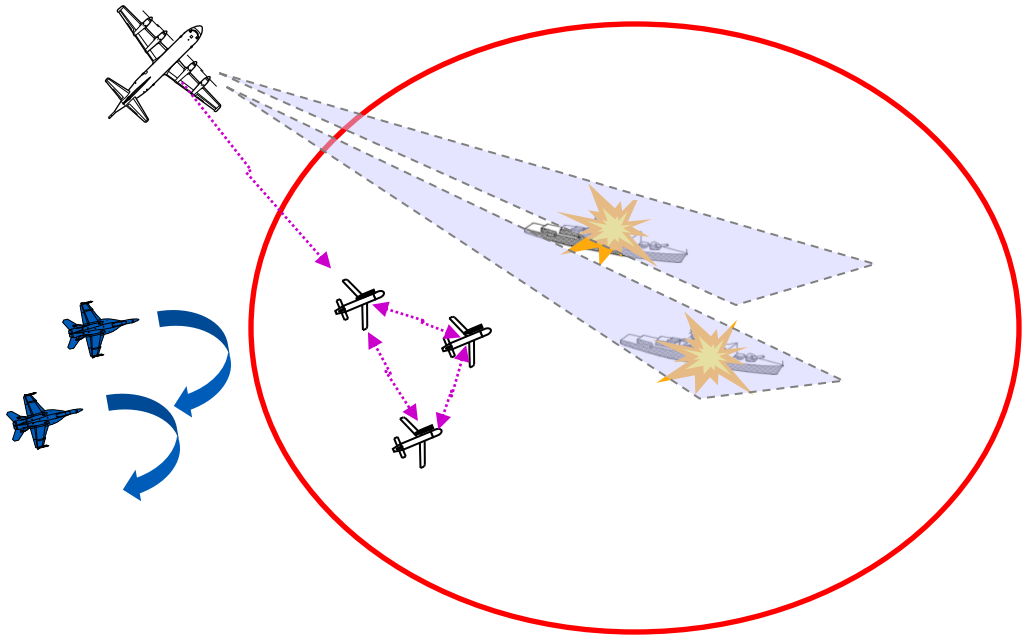
# Sensor to Weapon 3PS (S2W 3PS)

- **Enables Shooter to engage target from sanctuary**
  - Increases Shooter Survivability
  - Allows for a “launch and leave” capability
- **ISR and/or C2 platform provide IFTUs directly to weapon**
  - Improved targeting accuracy
  - Increased Pk



# Weapon to Weapon (Cooperative Attack)

- **Enables Semi-autonomous communications/coordination between multiple weapons**
  - Dynamic In-flight Retargeting/Reallocation
  - Synergistic use of Sensors
  - Reduced Salvo Size
- **Currently pursued via ONR sponsored POM14 FNC**
  - Common solution, weapon agnostic
  - Targeted Demonstration in JSOW C-1, Harpoon Block II+



# Near Term Challenges

- **Development of a NEW CDD/KPP that defines roles and responsibilities of platform participants (shooters, weapons, 3PS)**
  - Currently in development
- **Definition of future Network Architecture, i.e. L16, TTnT, etc.**
  - Awaiting direction from N2/N6
- **Identification of potential NEW platforms and weapons**
  - E-2D, BAMS, P-8
- **Funding for J11 message set incorporation in 3PS ISR platforms (N88/N89 seam issue)**
  - LSRS: POM 13 Issue Sheet submitted, **<u>currently below the line</u>**
    - $10M in FY13, $5M in FY14
    - JTIC certification, Chg 4 to MIL-STD-6016D ICP, Training materials, enhanced operator displays and controls
  - JSTARS


# Precision Strike Annual Review

## 20 March 2012

*Major Craig "Pebbles" McDermott*
*OPNAV N98*
*Air-to-Ground Requirements Officer*

# AIR TO GROUND WEAPONS ROADMAP

2.75”Rockets
5” Rockets
20MM/25MM
50 Cal

**Rockets/ MG Ammo**

HARPOON
1-C
SLAM ER

**Stand Off ASuW**

**Direct Attack**

GP Bombs
LGB/DMLGB
JDAM/LJDAM
Hellfire (RW)
Maverick
GBU-24/J109

**Stand Off Land Attack**

JSOW A/C
SLAM ER

**APKWS II**
**LOGIR**
**20/25MM**
**JSOW C-1**
**HARPOON II+**
**OASuW AoA**
**AARGM**
**LJDAM**
**GP Bombs**
**BLU-129**
**DMLGB**
**GBU-24/J109**
**SDB II**
**AARGM**
**JSOW C/C-1**

**Precision**
**Counter EA**
**Moving Target**
**Stand Off**
**All Weather**

# Strike Stand Off Weapons

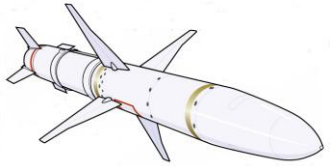
**JSOW Unitary (AGM-154C-1)**

- Adds Weapon Data Link/ Network Enabled Weapon (NEW), Maritime Moving Target Capability to the existing capabilities of the JSOW C

**Small Diameter Bomb II**

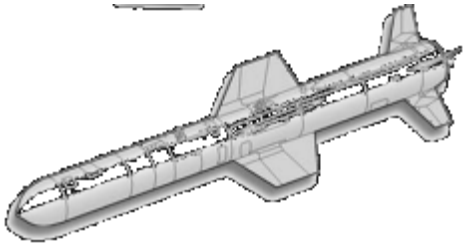
- Provides precision tactical standoff capability against mobile/stationary targets in all weather conditions using GPS/INS Enhanced Accuracy
- Tri-mode seeker (SAL/IIR/MMW) provides pinpoint accuracy and minimum collateral damage.
- Network Enabled Weapon

**Advanced Anti-Radiation Guided Missile (AARGM AGM-88E)**



- Destruction of Enemy Air Defenses (DEAD)
- Expanded Threat Coverage
- Enhanced Anti-Radiation Homing (ARH) receiver against heat generating high value targets.

**Harpoon II+ ()**



- Harpoon II+ provides a navigation upgrade to allow for increased reliability and improved target selectivity / survivability
- Network Enabled Weapon

# N98 Future Outlook

- Increased Range
  - AARGM
  - JSOW ER
  - JDAM ER / LJDAM ER
- Hard Target Munitions
- JSOW A Conversion
  - Cluster Munition to Unitary Warhead
- NCEA
  - Replacement of Live with Heavy Inert
  - Increases in Training Requirements (20mm, Hellfire, etc)
  - Constrained Weapons (SLAM ER, Harpoon, LMAV, GBU-24, etc)
- Science and Technology

# Precision Strike Annual Review
## Capabilities Based Acquisition

*March 20, 2012*

**Presented by:**
**Kerry Neace**
**Kerry.neace@jhuapl.edu**
**240-228-3406**

APL
The Johns Hopkins University
APPLIED PHYSICS LABORATORY

# Weapon Acquisition Challenge

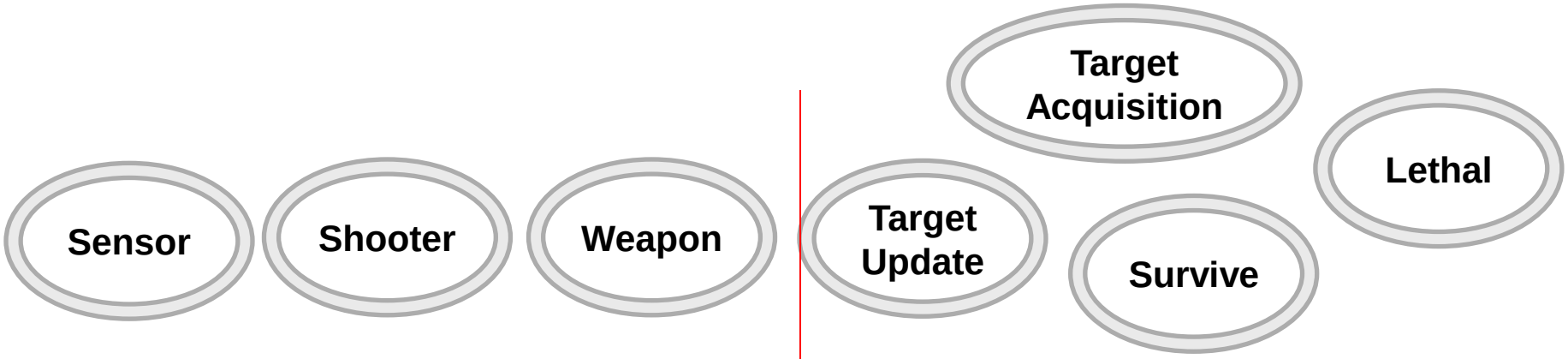
- **DoD faces an austere fiscal environment**
- **DoD plans to reduce/limit new-start MDAPS**
- **New capabilities must be achieved through the modification and integration of existing systems**

# *Capabilities* Based Acquisition

- **JCIDS – ICD, CBA identified GAPs, AoA in context of kill chain**
  - Identifies *requirements* for capabilities
- **CDD/CPD – Capability requirement documents**
  - Focused on *system* acquisition
- **System-of-system (SoS) = Design Options = Greater Opportunity**
  - Capabilities may be achieved through *one or more combinations* of systems in an existing/new portfolio of programs
  - "Non-traditional" allocation of functions (e.g., find, fix, track, ID) to constituent systems is part of the SoS solution space…
- **SoS solutions offer efficiency and optimization across mission areas; "more for less"**
- **SoS resource allocation ties investment to warfighting capability**

**How can DoD acquire capability?**

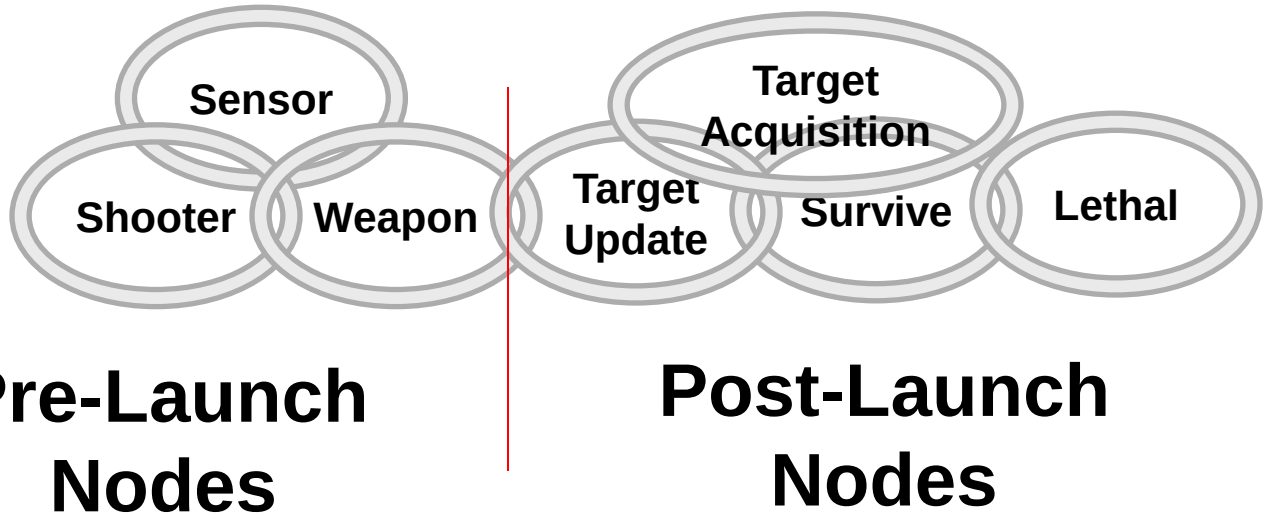
# Integrated Chain of Capability
## Example: Anti-Surface Warfare




**Pre-Launch Nodes** **Post-Launch Nodes**

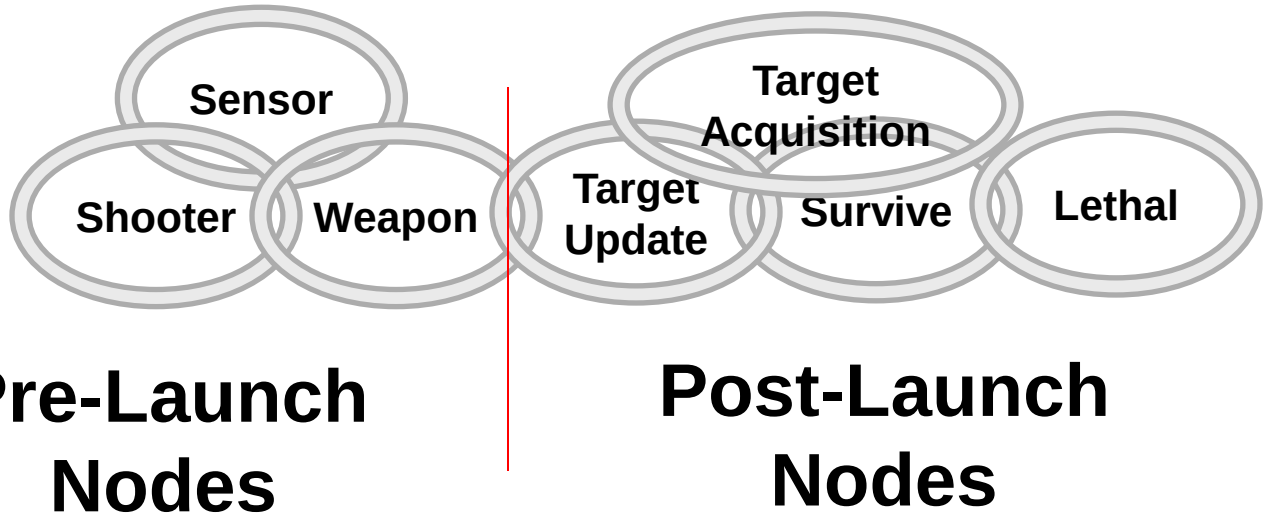
- **If Pre-launch and Post-launch capabilities are acquired and "optimized" without specific knowledge of prioritized overarching warfighting capabilities it is likely the integrated system will not be optimal**

# Integrated Chain of Capability
## Example: Anti-Surface Warfare




- **Understanding the complex nature of the integrated chain of capability helps determine the overall capability effectiveness.**

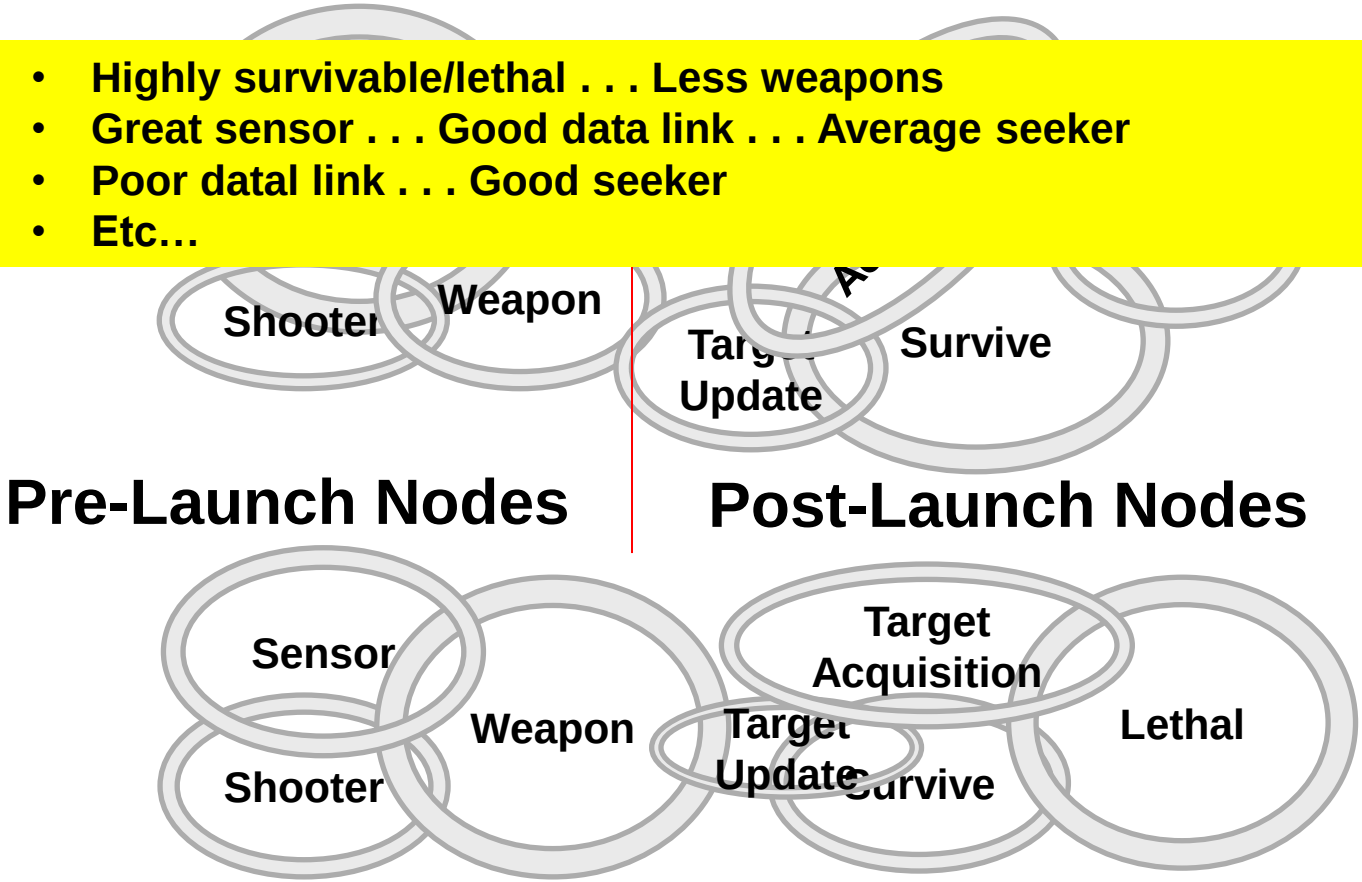
# Integrated Chain of Capability
## Example: Anti-Surface Warfare




- **Assume the size the link above is equivalent to system performance, and that when summed the areas within each "link" will add up to a required overall capability effectiveness determination**
  - EX: Overall Effectiveness = Salvo size needed for enemy SAG takedown

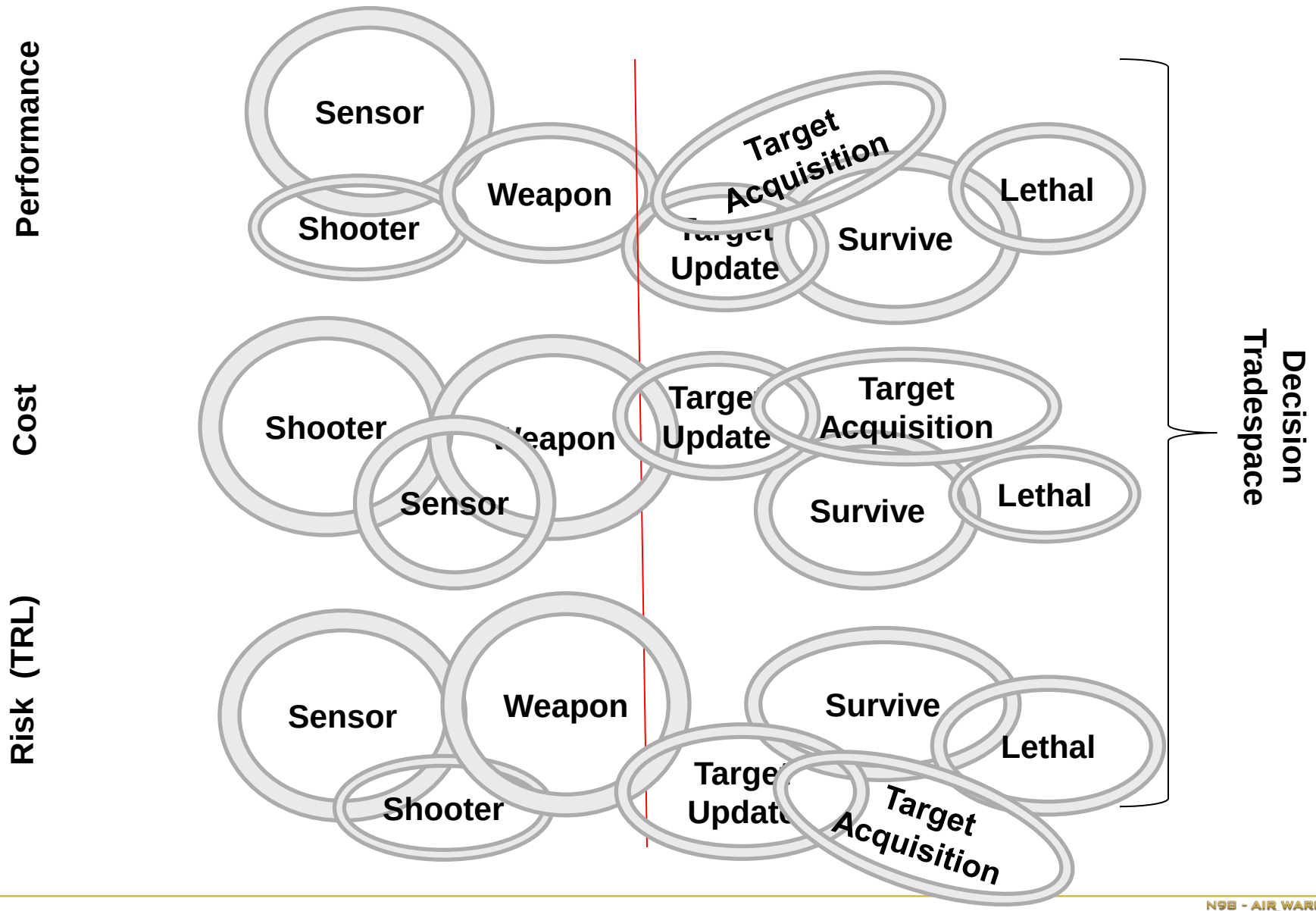
# Integrated Chain of Capability
## Example: Anti-Surface Warfare

- **Highly survivable/lethal . . . Less weapons**
- **Great sensor . . . Good data link . . . Average seeker**
- **Poor datal link . . . Good seeker**
- **Etc…**

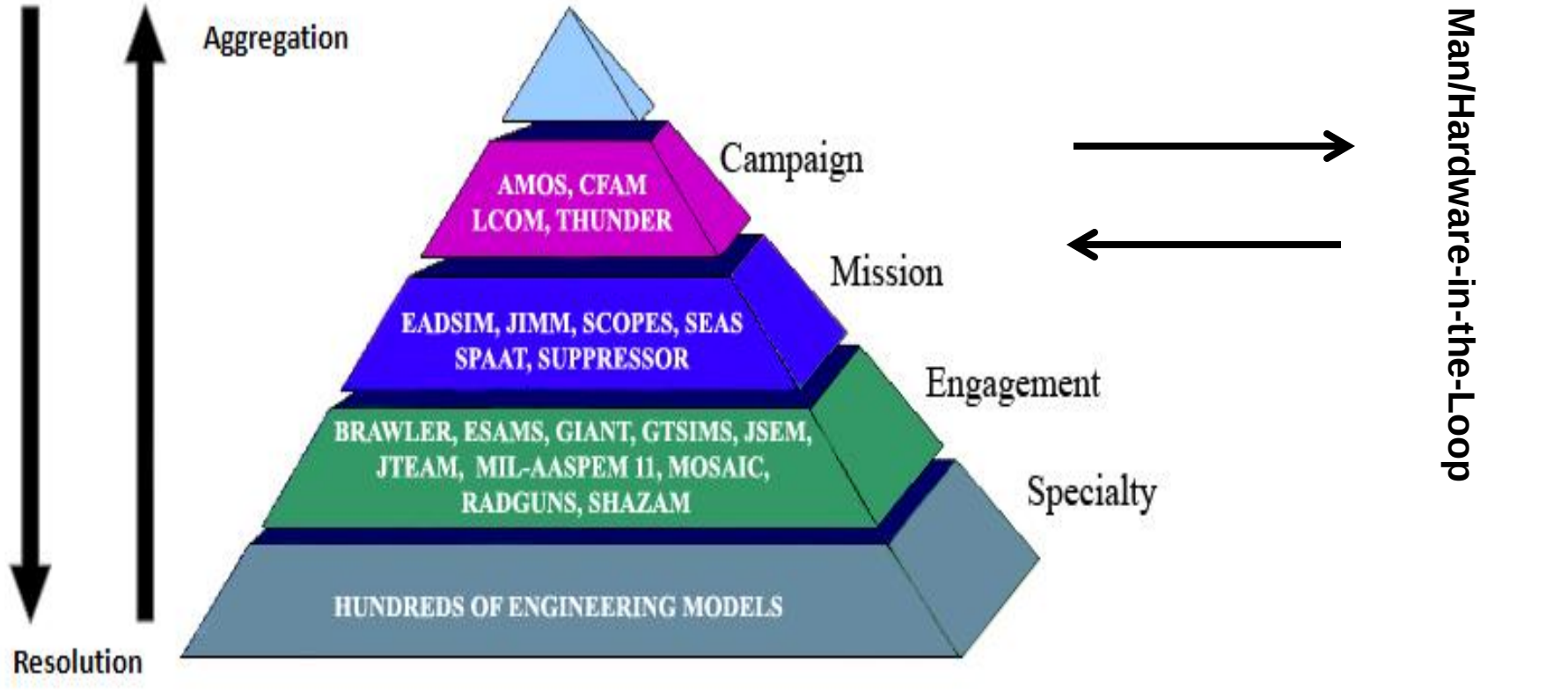



- **Different combinations of performance may "sum" to the same overall effectiveness, as each node's system performance has an effect on the performance requirements of the other nodes**

# Integrated Chain of Capability
## Example: Anti-Surface Warfare

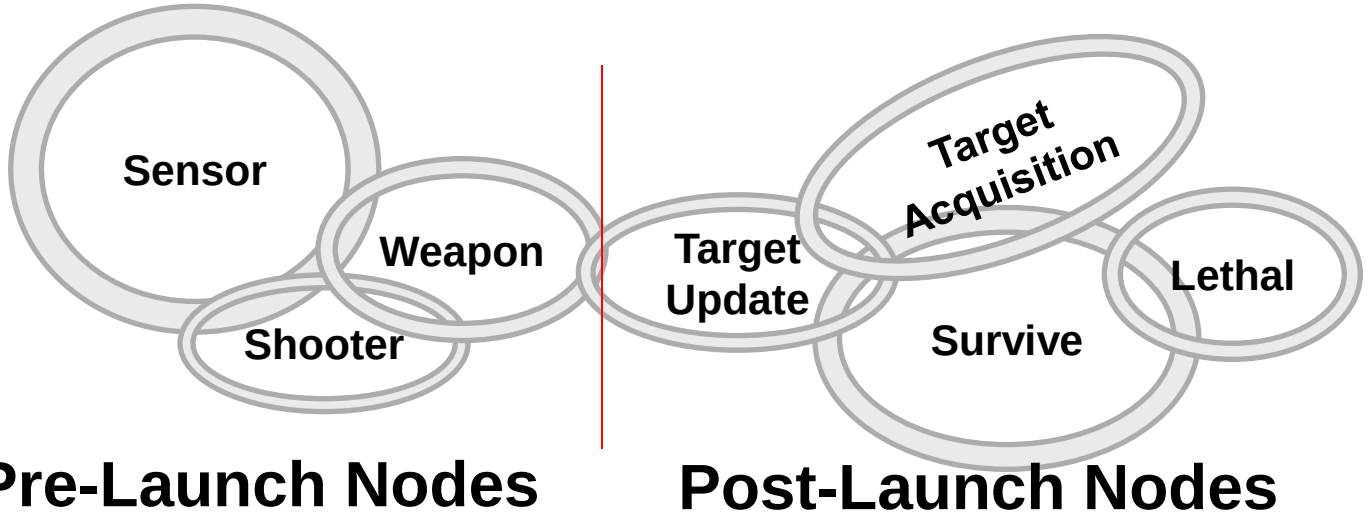


# Capability Performance Requirements Traceability
## *Where Simulation Can Help*




Live Virtual Constructive (LVC)

# Integrated Chain of Capability
## Example: Anti-Surface Warfare



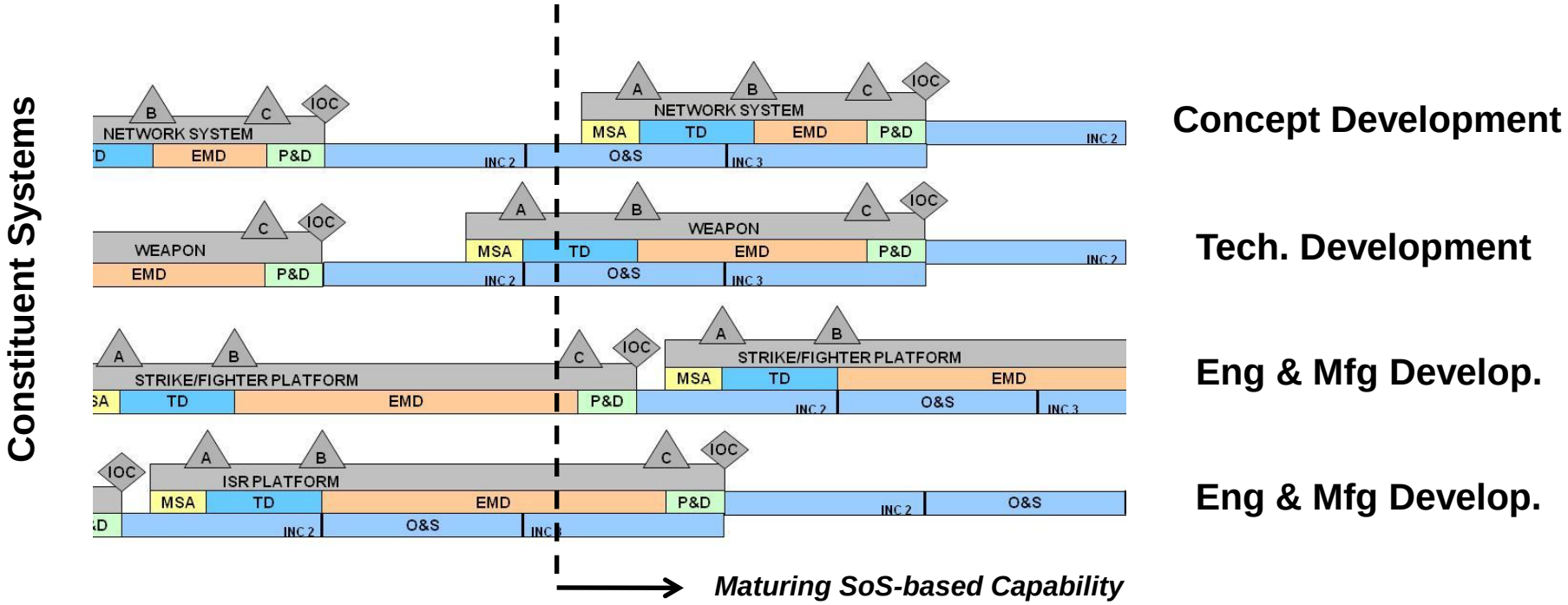

***Optimizing*** **the Integrated Chain of Capability to meet a warfighting need is based on performance metrics of feasible combinations that are linked to desired IOC (TRL), and costs (affordability).**

# Challenges to *Capabilities* Based Acquisition

- Orchestrating acquisition for asynchronous programs
- Authority for requirements and funding across multiple programs
- Program baseline thresholds may not support new capability
  - Characterize above-threshold performance & update documents
  - Identify “delta requirements” and institute modifications
- The need for accurate program models for capability-based mission analysis
- Capabilities achieved through SoS solutions can only be developed in collaboration. Teaming is paramount…Industry data sharing and GFI together offer potential teaming solutions

# Distributed Development

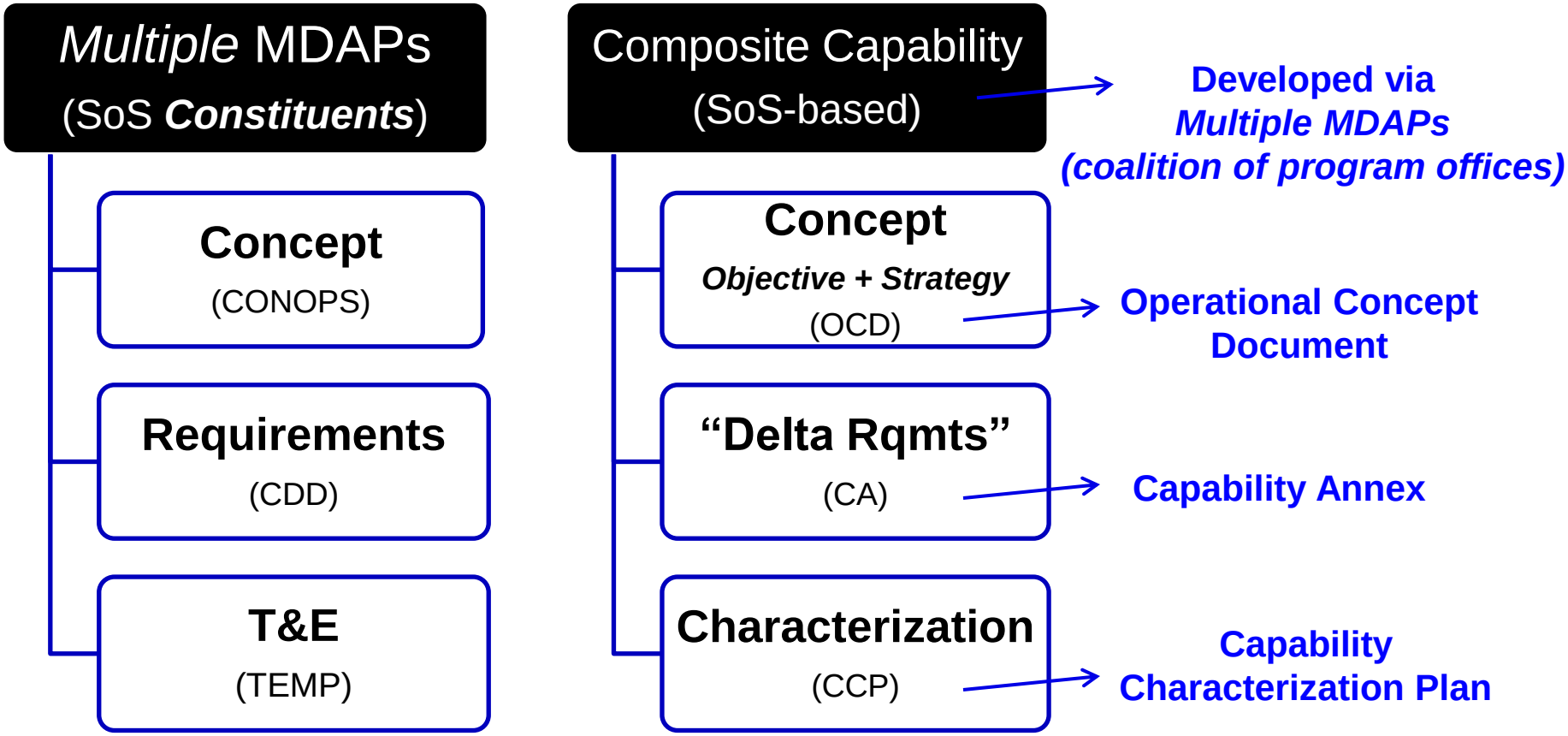
## *Executed through / by asynchronous MDAPs*




**SoS Process / Documents Must Guide *Simultaneous and Distributed***
**Concept Development (CD), Technology Development (TD),**
**Engineering & Manufacturing Development (EMD)**
***AND***
***Collaborative* Test & Evaluation (T&E)**

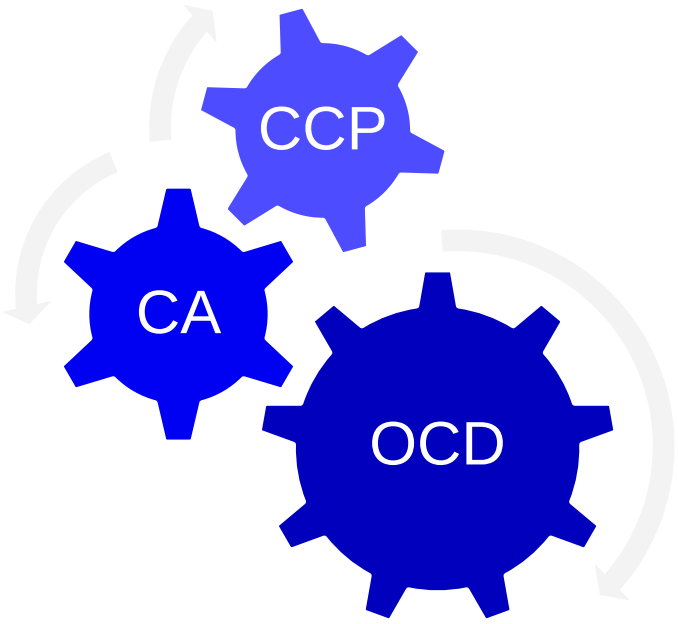
# SoS-based Capability Development

## *Systems Engineering Rigor…reflected in documentation*




**Compatible with *and* <u>*augments*</u> DoD acquisition processes, as it is *dependent* upon MDAPs for execution!**

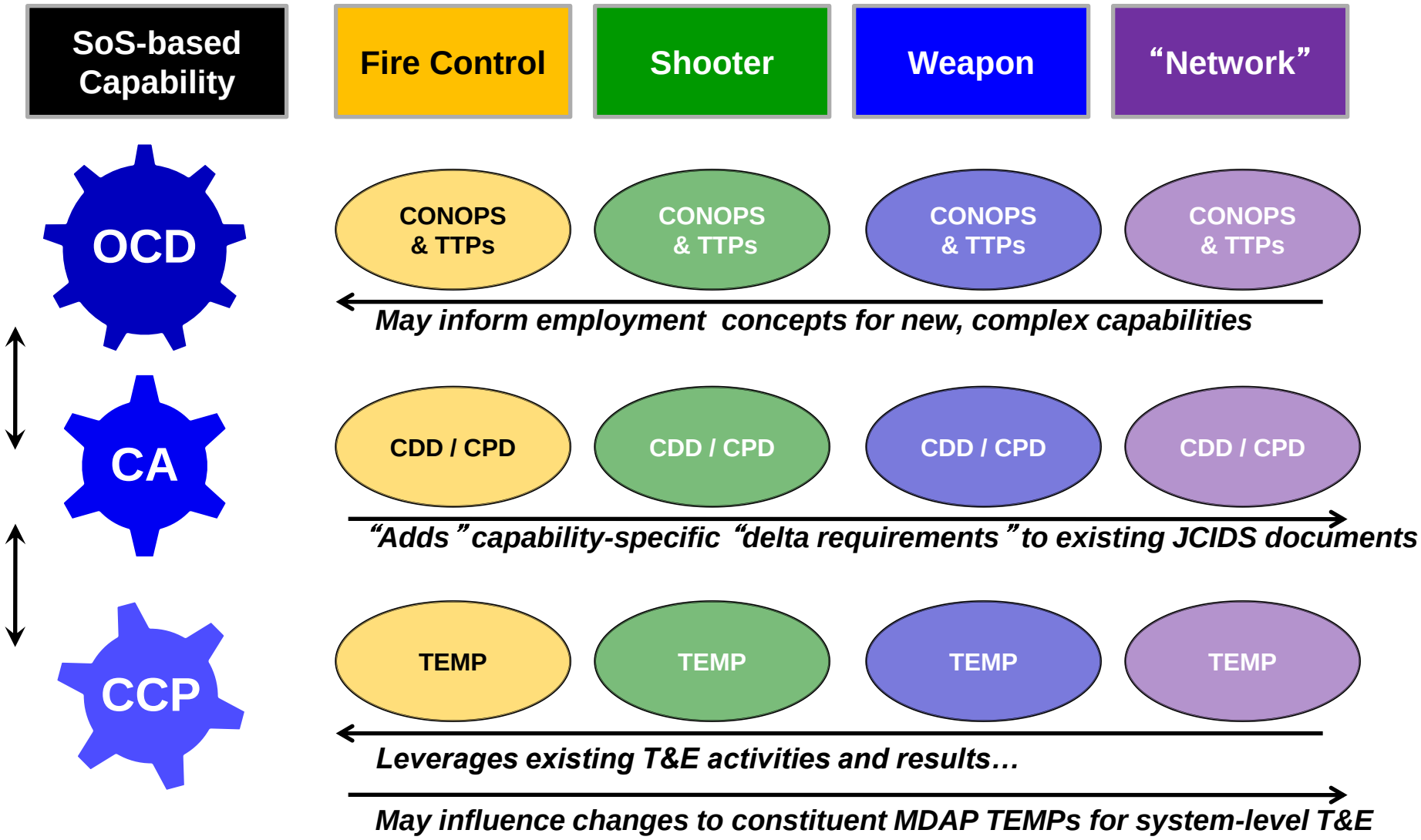
# SoS-based Capability Development Documentation




- **Operational Concept Document**
  - Adjunct to acquisition and Fleet "CONOPS"
  - Shapes the collaborative development environment (cross-MDAP scope)
  - Context & process for identifying *capability-specific* "delta requirements"
- ***Capability* Annex**
  - Documents SoS-based Capability
  - Augments constituent CDDs / CPDs
    - Derived / delta requirements
- ***Capability* Characterization Plan**
  - *Integrated schedule* for research, analysis, test and experimentation
    - Live / Virtual / Constructive

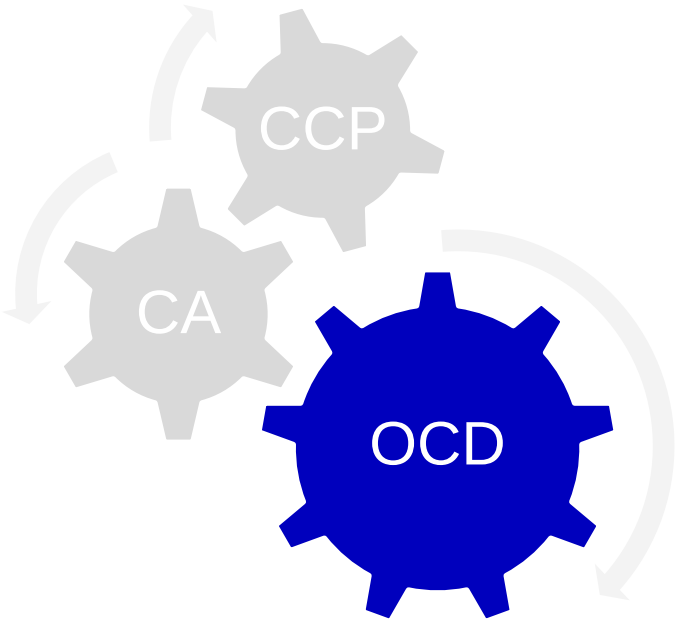
**Documents are *interdependent* & must remain aligned**

# Documentation relationships



# Shaping the collaborative environment

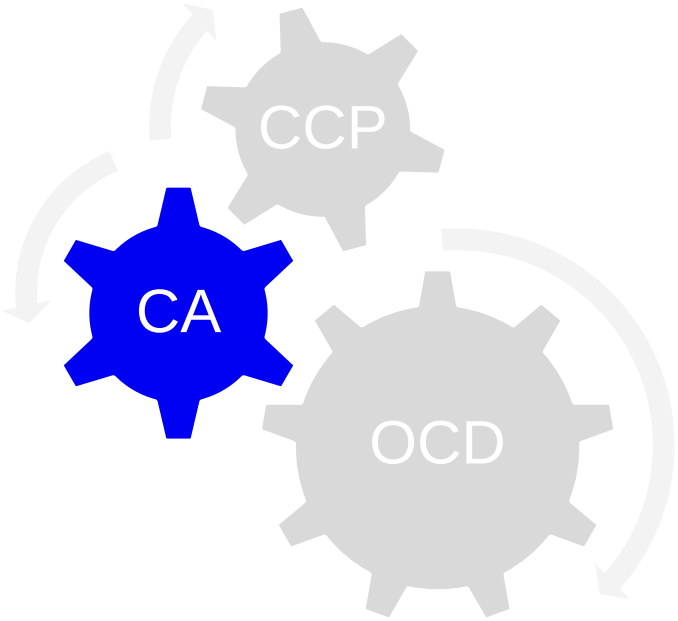
## *Step #1: Agree on the concept*




- **Operational Concept Document**
  - **Derives from:**
    - **Handbook of Systems Engineering and Management (definition)**
    - **ANSI / AIAA G-043-1992**
  - **Incorporates relevant content from:**
    - **Concept Proposals**
    - **Operational Concept Descriptions**
    - **DoD Acquisition CONOPS**
    - **USN Fleet CONOPS**
    - **Design Reference Mission Profiles**
    - **Test & Evaluation Strategies**

**Scope transcends constituent systems and MDAP offices**

# Implementing the SoS via MDAPs
## *Capability-specific "Delta Requirements"*

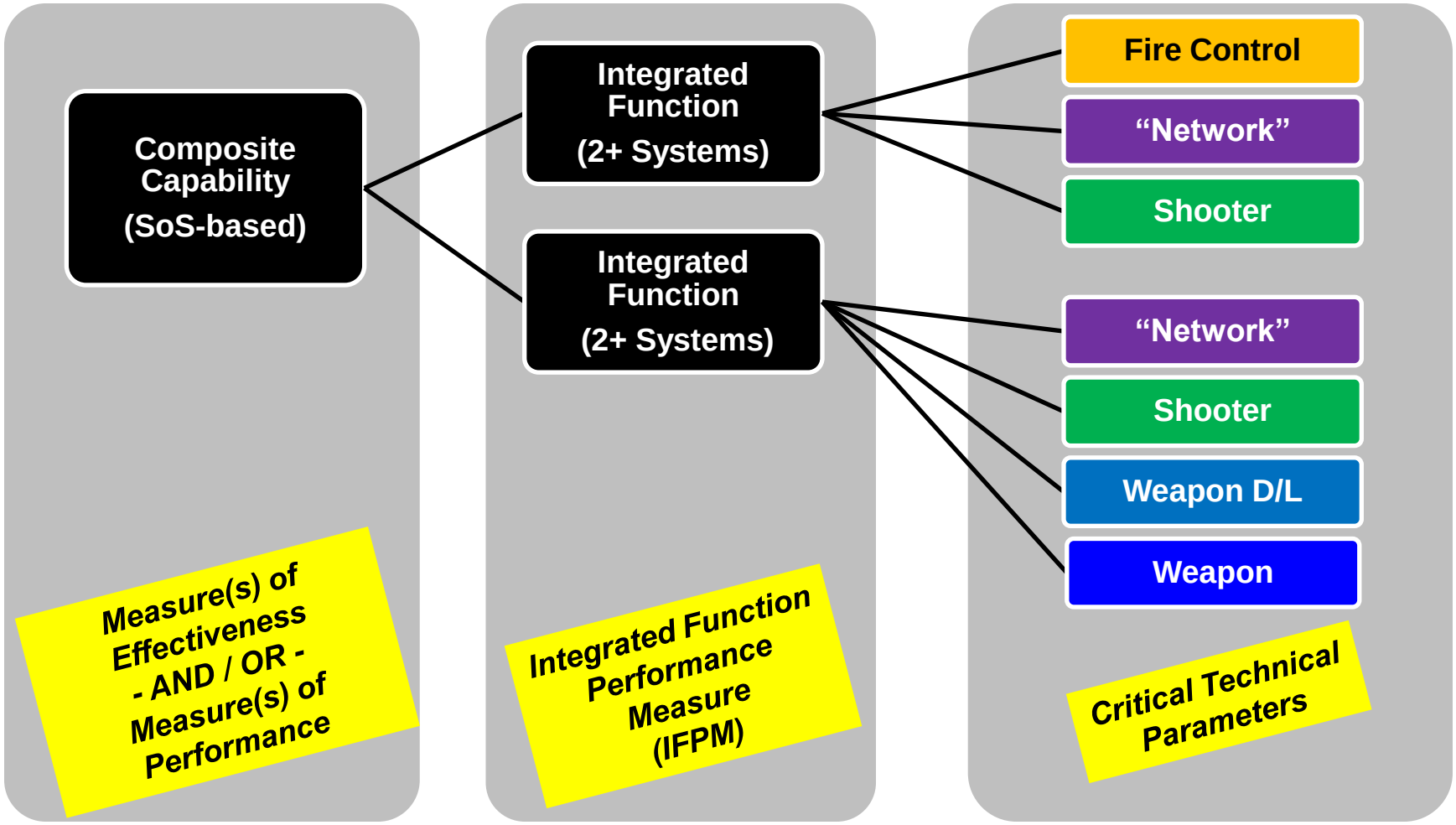



- **Capability Annex**
  - **High-level / SoS-focused perspective**
  - **Captures capability-specific "delta requirements" for constituent systems**
    - **Informed by the OCD**
  - ***May* include an "Interoperability Viewpoint" that incorporates one or more of the following:**
    - **Functional Decomposition**
    - **Physical Allocation**
    - **Mission Task Sequences**
    - **Information Exchanges**

**CA intended to augment the CDD for each constituent system**

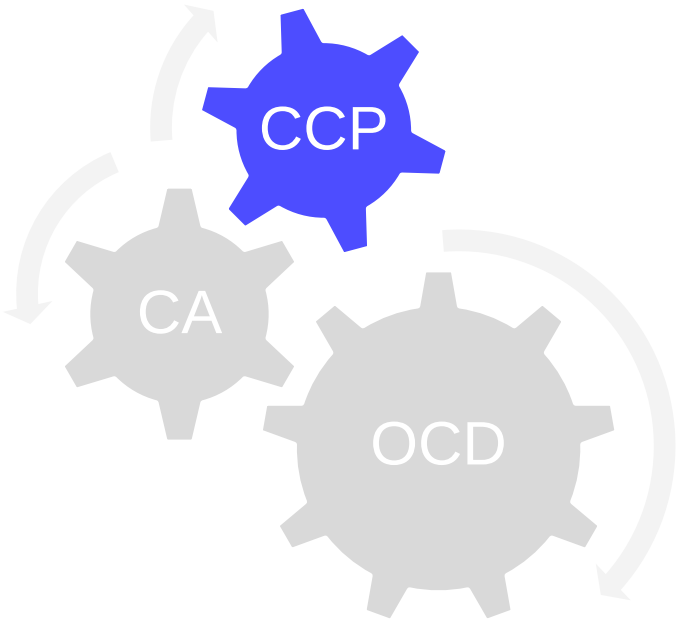
# Capability-Verification

## *With useful and consistent performance metrics…*



# Capability Characterization

## *The role of T&E in the context of SoS Development*




- **Capability Characterization *Plan***
  - **Predictive performance analyses**
    - **Constructive**
      - **Computer based / parametric**
  - **System-Level & Integration Tests**
    - **Virtual**
      - **Hardware & Operator in the Loop**
    - **Live**
      - **Demo / Prototype**
      - **Fleet Battle Experiments**

**Capability assessment is continuous and progressive.**
**Findings from all activities support**
***Observations of Operational Capability***
**and inform fleet introduction processes**

# Concluding Thoughts

- **Capabilities based acquisition offers potentially significant *efficiencies and affordability* in procuring warfighting capability**
- **SoS development requires modifications to the traditional MDAP acquisition processes**
- **Front end SoS and system engineering that includes a robust Modeling and Simulation tool set can identify optimal "Integrated Chains of Capability"**
- **Government and Industry can work together in a collaborative environment to support this analysis**
- **Methods exist in system engineering best practices to guide the acquisition community in SoS based development**

# Questions?